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No. 7.

THE AGRICULTURAL STUDENT



THE IMPROVEMENT OF OUR CORN CROP

HOMER C. GEORGE

THE QUESTION OF SPRAYING—M. H. BARTER

THE RELATION OF CLIMATE TO METHODS OF
SELECTING AND INTRODUCING NEW FRUIT
PLANTS—Geo. D. HUBBARD

DEVELOPMENT AND EVOLUTION OF SPRAYING
MACHINERY—HOWARD J. CAMPBELL

SOIL MOISTURE—H. C. GREEN

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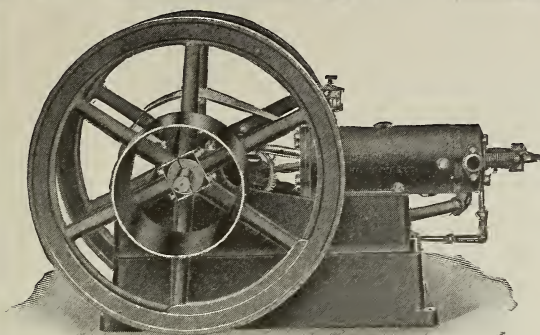
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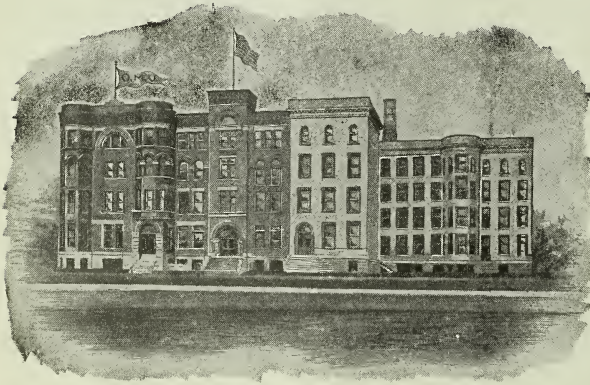
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THE AGRICULTURAL STUDENT.

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EDITORIAL NOTES

Several months ago the students of the Agricultural Society agreed that they desired to control the business managership of THE AGRICULTURAL STUDENT, the editorship being already in their control. Upon recommendation from a few of the Agricultural faculty members, a new constitution was adopted by the society, awaiting the indorsement from the Agricultural Faculty. Under this new constitution the new officers were elected. The new editor of THE STUDENT was to assume control of the paper by April the first, but owing to some delay the new man, Mr. Kinney, will not step into harness until the next issue. We hope that the paper will continue to increase in circulation and in valuable contributions as it has during the past year.

Congress lately voted to give each of the Land Grant Colleges \$5,000 for the first year and \$5,000 for each year after until the amount reach \$25,000. If they postpone the construction of the new farm buildings a while longer the Agricultural Department of O. S. U. will have quite a nice little sum for buying live stock.

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The Improvement of Our Corn Crop

HOMER C. GEORGE.

Farmers are realizing, more and more each year, that corn is our most profitable farm crop. Ever since the foundation of this country it has been considered the money crop of the farm. In fact, some even calculate on a year's profits as depending directly upon the number of acres of corn planted.

It is nearer true now than ever before that "corn is king." But kingly as corn is, it is not perfect. Much of the corn found in the markets today is of poor quality. It has great need of improvement and much interest is being shown along this line. Large profits are possible if reasonable care is given to this phase of farm work.

It requires twenty-five to thirty bushels of corn per acre to pay the cost of production and a fair rate of interest on the land. All above this amount is clear profit. Many farmers are producing sixty to seventy-five bushels per acre every year on an average soil and their methods are not by any means as they might be. Some are producing by somewhat improved methods as much as 100 bushels per acre. Many instances have been reported of small areas producing from 150 to 200 bushels per acre.

Owing to its variation, there is no crop more responsive to improvement than corn. From the millions of ears produced, some few ears can be found which will have almost any desired characteristic. This variation affords great opportunities for corn improvement. But in order to get the best results by selection and breeding, it is necessary at the same time to improve the environment. An improved environment induces variation along desirable lines. These variations are gen-

erally transmitted through the influence of heredity. Then by selection the variations are fixed.

The environment may be improved by better methods of tillage and cultivation and by increasing the fertility of the soil. The main object of tillage and cultivation is to conserve the moisture. More corn crops are cut short by an insufficient supply of moisture than by any other cause. Therefore the conservation of soil moisture is very important. The first thing needful is to allow the water to percolate freely into the soil and moisten the soil as deeply as possible. For this reason the soil should be kept loose by different means, times and frequencies of tillage. When ground is plowed in the fall, it acts during the winter and early spring as a mulch diminishing the loss of water by surface evaporation and at the same time the roughened surface tends to hold the snows and to permit winter and early spring rains to penetrate more deeply into the soil. In some regions fall plowing is essential, but in other places the washing of the soil, loss of plant food, and puddling of the soil, make it undesirable. In such cases early spring plowing is very advantageous. After the soil and subsoil have been supplied with moisture the next important consideration is that it be kept constantly within the reach of the crop and still not be lost into the atmosphere by evaporation. This is done by means of cultivation. The object is to get a fine pulverized, dry soil two or three inches deep over the surface. After these mulches have stood sometime a crust is formed and capillarity is restored, thus making necessary another cultivation.

Besides conserving the moisture, cultivation also improves the physical condition of the soil. Some soils pud-

dle much worse than others, depending upon their texture. The greatest danger is in plowing the ground too wet thereby destroying its texture and causing its particles to run together. Then soils may, also, be allowed to get too dry before plowing when it will turn over in large clods and is almost impossible to get in good condition. The water content should be such that damp soil when squeezed in the hand will hold its form, but will easily crumble to pieces and not be at all pasty. The particles ought to be neither too fine nor too coarse. If the granules are too small the water moves too slowly. In soils that are too fine in texture, lime may be used to flocculate the soil particles and improve its physical condition. If the soil particles are too large, the water will drain away too rapidly. For these soils stable manure is especially valuable. It acts like a sponge in absorbing the rainfall. Not only is less water evaporated from a well manured soil, but water drains away less rapidly and it brings water up from below by capillary attraction. Cultivation also destroys the weeds and may aid in raising the temperature.

Stable manures are also valuable in adding to the fertility of the soil which is the second means of improving the environment. Commercial fertilizers, when used, are often found to be beneficial, but the results from stable manures have been found to be so much more satisfactory that commercial fertilizers are seldom used.

After putting the soil in the best possible condition one should next try to get as near as possible a perfect stand. Many a field has been planted over because of a poor and uneven stand. Imperfect stands are generally due to two factors, first, the low vitality of the seeds planted and, second, the uneven

dropping of the kernels by the planter. All corn used for seed should be tested for vitality several weeks before the seed is required for planting so that in case it is not good there will be sufficient time to get a new supply. Each ear should be tested by itself using five grains from each ear. If any ear fails to give complete germination, it should be discarded as the failure of a single grain to sprout would mean only 80 per cent germination. The second factor, that of uneven dropping of the kernels, may be remedied either by selecting kernels of approximately the same size and shape or by grading the kernels into two or three sizes. Next the planter should be tested and the proper plates selected for each grade. If the proper plates are not at hand those nearest may be calibrated to do the work desired. It is possible in this way to plant corn with remarkable accuracy. If the farmer would test the vitality of all corn used for seed and then grade it so that the planter would drop the proper number of kernels in each hill, it would greatly increase the yield of corn.

The importance of a full stand is shown in the following illustration: A small experiment plot of corn was grown in a field of the same kind of corn, only that the corn planted in the plot was of an inferior grade, some being the worst that could be found, while that planted in the field was well selected seed corn. The corn used in the plot was tested for vitality and planted by hand and later thinned down to three plants per hill. In this way almost a perfect stand was secured. The large field was planted with a planter and the seed was not tested for vitality. The plot yielded eighty bushels per acre, while the field yielded about fifty bushels per acre. Except one early hoeing

at the time of thinning, of the experiment plot, the cultivation was the same, Here is a difference due almost entirely to the imperfect stand.

The next great means of improvement is to improve the inherent characteristics of the seed. This includes the selection and breeding of corn. A person may breed for many different characteristics, but the most important of these is the increased productiveness of the seed. There is a wide range in the productive powers of different ears. The Iowa Experiment Station planted the most perfect kernels from 102 of the best ears in rows side by side, each row being planted with kernels from a single ear. At husking time each row was harvested by itself and a record taken of the yield of each individual ear. The average of the ten highest rows was 83.71 bushels per acre, the highest yielding row producing at the rate of 90 bushels per acre. The average of the five lowest yielding rows was 40.05 bushels per acre, the lowest yielding row producing only 36 bushels per acre. Therefore, by selecting ears from the highest yielding rows it has been found possible to greatly increase the productiveness of the seed.

To carry this plan on more systematically the ear to row test plot has been devised. The plan of Mr. Williams, of the Ohio Experiment Station, is to pick out 100 good ears and then later select forty of the best of these. Then after running a germination test, twenty-five of the best germinating ears are selected. Then using one-half of the ear, the kernels of each ear are planted in a separate row. Five or six ears are shelled and well mixed together and used for check rows, every sixth row being planted as a check. At the first harvest the four highest yielding rows are selected. The next year the other

half of the four highest yielding ears are taken and planted in two small isolated plots, two ears in each plot. The plants grown from one ear in each plot are detassled. This prohibits self-pollination in the detasseled stalks. About fifty of the best ears from the better one of these two crosses are shelled, well mixed and planted the following year in the multiplying plot so as to get seed for the general field. One of the difficulties is the isolation of the plots, but only the breeding and possibly the multiplying plot need be isolated. All systematic breeding for the improvement of productiveness of the corn crop in Ohio is done on this plan.

We may next breed to improve the chemical composition of the corn. Different parts of the kernel are high in certain food materials as the germ which is high in oil, the horny layer next to the hull which is high in protein, and the starchy part around the germ which is high in carbohydrates. It has been found that the kernels high in any one of these food materials will produce ears the kernels of which are also high in this one food material. It is not necessary to analyze the kernels to determine whether a kernel is high in any one food material, but this may be and is done mechanically. The Illinois Station has done the most work in breeding for high and low oil and protein content. In seven years they have increased the protein content to 12.32 per cent. and decreased it to 8.32 per cent., making a difference of 4 per cent. In ten years they have increased the oil content to 7.3 percent. and decreased it to 2.56 per cent., making a difference of 4.74 per cent. in oil content.

Breeding for high protein content is

advantageous in the north where corn is the principal feed for farm animals. It makes a more balanced ration in case corn is fed alone. High oil and starch content is desired by manufacturers in the production of corn oil, starch and glucose.

Third, we may breed to improve the physical characteristics of the ear and stalk. Such characteristics of the ear as slender ears, pointed ears, ears with poorly filled tips, crooked and irregular rowed ears, deep and shallow kernels and many other characteristics that might be mentioned are strongly hereditary. Seed from some ears will produce many more barren stalks than others. If we desire to rid our fields of barren stalks we must select seed from ears which will not produce barren stalks.

We can also raise and lower the height of the ears on the stalk. In one year the Illinois Experiment Station by selecting one lot of ears borne seven or eight feet from the ground and another lot three or four feet from the ground, got an average difference of eighteen inches in height when the two lots were planted side by side.

Another means of improvement which does not come in any one of these classes is that of detasseling. The Illinois Station by detasseling alternate rows and selecting seed from detasseled rows, in three years increased the yield eleven bushels per acre. The advantage of this is that it absolutely prevents self or cross-pollination. It is used at present only in the breeding plots.

By means of these methods, either all or perhaps only the more important ones, there seems to be no reason why the average farmer could not easily increase the yield from twenty-five to fifty bushels per acre.

The Question of Spraying

M. H. BARTTER.

Success in agriculture depends primarily on the growth of plants. This growth in turn, depends on three fundamental operations—cultivation, fertilizing and spraying. It is evident that plants must grow before they can produce, and usually this growth depends more on proper cultivation, and sufficient plant food, than on absolute freedom from insects and fungi. The time has passed however, when we can expect fine fruit, vegetables and grain without taking into account the organisms that affect plant growth. These enemies have come rapidly from the north, south, east and west. Their great increase is the natural result of our transportation facilities, the extended use of agricultural products from every part of the world and the excellent breeding places afforded by our modern extensive fields and orchards. But thanks to scientific agriculture, our knowledge of controlling them has advanced accordingly, so that remedies of a few years ago seem foolish, and impracticable; then every farmer had his special remedy to use for all troubles. Now man's power over all these enemies is almost complete. There are few that cannot be held in check at least, by modern methods. One by one their life histories have been studied and their weak points found. For only by knowing them thoroughly can we check their ravages in an economic and efficient manner. Our conclusions and present actions are founded on facts. Many are controlled by rotation, others by introducing natural enemies, and scores by our improved fungicides and insecticides, applied by our modern sprayer.

The principle fungicides used in spraying are certain salts of copper, es-

pecially the sulphate. These salts were first experimented with in France for the downy mildew. This was destroying all their vineyards. Lime and copper happened to be used together to give the vines the appearance of having poison on, to prevent stealing. It was clearly seen that these vines were free from disease. M. Millarde conducted a number of experiments and succeeded in perfecting the mixture. Thus the bordeaux mixture came to be the salvation of the grape growers first, and then to be used universally. Its points of merit are its thorough effectiveness, cheapness, safety from a hygienic standpoint, and harmlessness to the plant. The arsenicals may be added to this, making a combined fungicide and insecticide of great value. Arsenic in some form and copper carbonate are advised for the last spraying of fruit, to prevent the lime coating left by the bordeaux.

The insecticides are of two classes, eating and sucking. The first are destroyed by eating the poison with the foliage. The arsenicals such as paris green, arsenate of lead, london purple, etc., are usually used here. Hellebore and pyrethrum are also valuable at times. Of the substances used for the sucking insects, kerosene, either pure or in emulsion, and the lime, salt and sulphur wash are invaluable. The Ohio Experiment Station issues a "Calendar for the Treatment of Diseased Conditions in Plants." This gives a full list of fungicides, insecticides with directions for using; "Seed and Soil Treatment," besides a complete spray calendar, telling insect or enemy, with what to spray and when and how often the work is necessary.

Foremost among the great steps in our recent advancement has been the

perfecting of the sprayer. With this, substances having a harmful effect on insect and fungus life are distributed over all the outer parts of the plant. What the self-binder has been to the grain grower, the sprayer is to the present raiser of fruits and vegetables. Without it he could not compete with the many pests in their fight for the harvest. The spraying machine should be durable, easily worked, not too expensive and brass lined. The cylinder should be large to give the force necessary for a fine spray. For the general farm the barrel sprayer is the most satisfactory. With this mounted, one can spray the vegetables as well as the orchards. Where large areas are treated power sprayers are better, especially with such crops as potatoes and cotton.

As to the amount of spray to use, a safe rule is to moisten every point of the foliage and fruit. As soon as dripping begins stop. Otherwise the material will gather in drops making an excess on some parts. On this subject Prof. Bailey says, "Spray thoroughly or not at all. Fully one-half of the spraying I have seen in western New York was a waste of time and material. Squinting a few quarts of a mixture on a tree is not necessarily spraying it. A plant or tree is thoroughly sprayed when it is wet all over. If there are places untouched, there is where future trouble will begin. Those who spray thoroughly and honestly are the ones who will make it a success in the long run. In all lines of work today, it is the best that is in demand. The best usually brings the most profit and the poorest the least. Now it rests with the grower whether he will be a man, and produce an article worthy of his time or not.

Lucina Tayabas, P. I., Dec. 11, 1906.

My Dear Professor: You have no doubt heard ere this that I received an appointment as teacher in the Philippines in September, just a few months after we had moved from Columbus to a farm near McMinnville, Tenn.

We accordingly sold the Tennessee farm at a fair advance considering it was a quick sale and I left for Manila on October 12. Mrs. B. and the boys have returned to Columbus and will remain there this winter.

I sailed from San Francisco October 20 on the Pacific mail steamship Doric and arrived in Manila November 16. We had an unusually pleasant passage, having only one day of really rough weather, that being just before entering the Strait of Formosa. We stopped two days at Honolulu and the passengers of course all enjoyed the time allowed. Honolulu is certainly a very lively place and many of the passengers that had never had a view of tropical scenes were ready to make Honolulu their home. The place resembles Kingston, Jamiaca, very much, but the islands themselves are of course very rough and barren and outside of the places where there is irrigation are not particularly inviting.

I was also fortunate in getting a pretty good general view of Japan as we stopped at Yokohama, a day at Koba and one at Nagasaki.

I spent one day in Tokyo visiting the principal sights of the Imperial City. We kept together about ten Americans and of course went around in the "rika-sha" and I noticed that in some quarters of the town we were objects of considerable interest and I have reason to believe, of some unfavorable comments, though no indignities were given us. At Nagasaki I had the pleasure of going

through several of the public schools, one primary, one intermediate and one normal school for teachers. One cannot fail to notice the intense national spirit at present manifest among the school children. We passed through the famous "Inland Pen" between Kobe and Nagasaki in the day time and I suppose one receives about the same impressions as one would by a cruise among the Alaskan Island or among the Islands of Norway and Sweden.

After leaving Japan our ship takes a course to within eighty miles of Hong Kong before setting course for Manila. We were fortunately favored with good weather across the usually boisterous China sea and in due season steamed into Manila bay. I was only able to stay in Manila a few days, so did not get around very much there. The impression I did get of the place is not very favorable and I am quite well satisfied to be outside of Manila on account of health if nothing else.

I have been sent to this place to organize a school of agriculture at present to be connected with the high school of the town. I believe that it is anticipated that this school will eventually become the high school of the province. Tababas is a very large province, extending quite 200 miles north and south. (I think you will not find the boundaries as at present correctly given in any map you may have.) Just at present I am giving a course in "Animal Life" and "Plant Life" and "Agriculture" to a "Teachers' Institute" in session here for one month. I have two sections in each class of the animal life and plant life with an average of nearly fifty in each and about thirty in the agriculture. The results will be far from satisfactory to some of the pupils for several reasons, but it may be the beginning of some good work. These

teachers are all Philipinos and understand English very imperfectly. This makes teaching by the lecture method difficult. They are not able to take notes unless I write on the blackboard. It is equally difficult, in fact impossible, to do outdoor collecting because of the size of the classes and lack of equipment and facilities for this kind of work. Although there are a number of small books published having in view the teaching of nature studies here, I have absolutely nothing of value in the way of a botany or zoology of the Philippines.

The plant life, however, I find very much like that of Mexico and Central America, but the native names of the common plants are difficult to get hold of as there are so many different names for each.

The American teachers here are generally supervising teachers. They, of course, teach in the larger schools, but much of their time is taken up in teaching the native teacher and supervising the other schools in their districts.

I anticipate that I will like the work to which I am regularly assigned, though the results may not come as fast as I would like. We will start a school garden at once and it is the intention to secure a larger tract of land for experimental and illustrative use. This is a cocoanut growing locality, thousands of pounds of the dried "copia" being shipped from this point so it is the intention to put out several thousand cocoanuts that we may be able to exhibit a well cared for cocoanut grove.

One of the boys in one of my classes tells me that he has a brother in the Ohio State University.

Will you kindly ask Mr. Graham to send me the bulletins of the Ohio State University extension work? I expect

to have an opportunity to do more work here in the way of improvement of the grounds around the high school.

Although there is no doubt that there has been a great change for the better since 1901, there is still much lacking in the social, education and economic conditions here to make the country anything like the United States, or place the people on a plane capable of self government. I always have been and am now only the more disgusted with a certain class in the United States who are constantly wasting sympathy on the Philipino.

I will be glad to have a line from you. With best wishes to you and yours, I am,

Yours truly,

L. M. BLOOMFIELD.

What the Winter Course Means to Us

The winter course means to us far more than we will be able to realize. It means more than book instruction. The knowledge obtained from books is the only fundamental principle of an education. It means the broadening of our views on subjects outside of the regular line of study but relative to our welfare in common. This is brought about by our associations with our fellow students. And by the associations we are forming acquaintances and friendships that will be lasting and invaluable to us.

We have arrived at the point where some of our farm operations have become unprofitable on account of the scarcity of farm labor and the depleted condition of our soils. And on this account we are compelled to change our methods to suit these varying conditions. We are being taught the importance of advanced methods in farm operations as compared with those that have been in practice for years, robbing the

soil of its fertility and in many cases forcing the owner to the wall or compelling him to sell out. These conditions have long existed in the East and are becoming noticeable here and are largely due to poor management.

In the winter course we are being taught the best methods of farm management, including the different kinds of farming and their relative effects upon the soil, giving us a comparison that we may choose the kind best adapted to our conditions. In each department of the course we have learned the theory of the work and its application.

We have learned to more fully appreciate the advantages we now have, compared to those our fathers have had not only in improved machinery and improved methods, but in the vast amount of good literature obtainable on all subjects. Reading is a pleasure not fully appreciated. As Emerson says, "Give me a good book, health and a spring day, and I will make the pomp of kings ridiculous." In reading we must not confine ourselves to one class of literature for it will make us radical and one sided and not capable of fairly considering the many questions which come before us every day. We have been forcibly impressed with this subject of reading and studying in this winter course. For if we had properly applied ourselves to the literature on the subjects pertaining to our course, previous to coming here we could have made better progress.

We have learned in connection with the importance of reading the greater importance of making our brains perform a larger amount of the labor. We have had the privilege of meeting and hearing the most prominent men from all over the country who have attained a success in their special lines of work.

These men have become successful through intelligent effort and ambition.

By hearing these men we are impressed with the fact that there is always room at the top of all industries, but to attain the top one must have perseverance.

The winter course is giving encouragement to stay on the farm, stick to our work and boldly face the various problems that are continually confronting us. It is true we sometimes get discouraged but if we look about us we can see others laboring under greater difficulties without complaints and this should encourage us to greater efforts and to make the best of our surroundings.

The winter course has done much in the way of impressing us with the importance of the little things about us that are being greatly neglected, but which go to make up the larger ones. The neglecting of these little things has been the source of many of the failures in agricultural pursuits, especially in extensive farming.

There seems to be a tendency or desire toward going west. This winter's schooling has taught us that there are as many and as good opportunities here in Ohio as are found anywhere in America.

I often think of the opportunities that exist all about us only waiting for some one to improve them. And it may be that some of the students of the winter course, acting upon the information received in this short course, will bring some of them to account. We have learned to be better judges of livestock, farm machinery, farm crops and farm values which will mean, or ought to mean much to ourselves and to our neighbors. By educating ourselves we educate others or in other words we radiate what we are. It is our sacred

duty to improve our opportunities in every way and set examples that our associates may be benefited by them.

There has been an inclination among the young men of the farm to feel that agriculture is a second class occupation. But we have learned differently. By the perseverance and enthusiasm of our college professors we have been inspired to elevate agriculture far beyond its present high standing.

Agriculture has for ages led the world as an occupation and today stands second only to graft.

Each student has certainly received benefits enough from this course to more than pay him for his time and expense. And one idea alone may cause a change in the life work of some one that will benefit a whole community. The winter course has shown us what college life really is and its great importance as a factor in education and advancement. We have been infused with the college spirit and learned to yell ourselves hoarse and sing our Alma Mater's praise. In fact the winter course has meant so much that we must leave the results to speak for themselves.

A Winter Course Student.

***The Relation of Climate to Methods
of Selecting and Introducing
New Fruit Plants**

GEO. D. HUBBARD.

There are three methods of studying the problem of the relation of plant to climate.^a First—physiological—to determine the functions of the various parts of the plant, their relations to the

air and other physical elements and their interrelations. This method is carried on by observation, measurement and detailed study of the plant in its normal habitat. Second—experimental—testing various plant processes in conditions, diverse but always known and under control, not only to find most favorable conditions for the plant but to find its range of adaptability and to produce new varieties. This is a part of the espoused work of the Experiment Station. Third—statistical—largely a comparison of crop statistics and climatic statistics.

I want first to point out a few phenological relations as revealed by the use of the first two mentioned methods. The climatic factors most important from this point of view are sunshine and heat, and moisture, both that received by precipitation and that in the air and soil. Another factor very important to the plant itself is the soil.

Sunshine may be considered independent of its heat effects. It involves as its working materials the soil and the atmosphere, with the moisture of both, plus the vital principle in the seed and the plant. In its presence the chlorophyll of the plant decomposes carbon dioxide (CO₂), and the carbon is built into the tissues of the plant while the oxygen is exhaled. A good climate is one in which the sunshine can find, and, aided by the vital principle of the plant, can use the above mentioned working materials for the building up of the plant. An unfavorable climate is one in which the plant cannot make progress against various climatic vicissitudes.

No plant develops without solar energy. The intensity of this energy varies greatly over the earth. Within the tropics the successive days of about twelve hours each with a sun nearly

^aAn address given before the Horticultural Society of the Ohio State University, January 28, 1907.

a. Abbe—Climate and Crops, pp. 6-7, U. S. Dept. Agr. Weather Bureau, Bul. No. 36. W. B. No. 342, Washington, D. C., 1905.

directly overhead, bring to the plant intense perennial sunshine. In the temperate zones the average intensity is much less although the actual number of hours of sunshine is the same as within the tropics. Both the more intense part of temperate zone sunshine as well as the long periods of exposure are bunched in the summer months giving to these months more sunshine than any equal time ever receives in the torrid zone but leaving the colder portion of the year so short on sunshine that the temperature on many days does not rise to the freezing point. In the polar zones the exposure is just as long in the course of the year, but the intensity is again reduced and the exposure is even more bunched within the summer months. Other degrees of sunshine are found in mountain tops, in deep water, under dark forests and in open field. Each plant's structures are more or less adapted to carry on its processes in certain exposures; and in so far as adjusted the plant is limited for its best growth to these certain sunshine conditions.

In a similar manner temperature influences, modifies or controls the plant's activities. The accompanying table shows that so many days at a certain temperature, more days at a lower temperature, or less days at a higher temperature, are necessary for the development of certain cereals. A similarly determined period is probably just as essential for the maturity of other plants, fruits etc. The fourth column gives the number of days required for the maturing of the grain at each station, the fifth gives the mean air temperature, centigrade, during those days, and the last column gives the product of the number of days and the degrees in the average temperatures, i. e., the

number of day-degrees required for the maturing of the plant.

Plant—a	Place of Test	Lat. N. of Place	No. of Culture Days	Mean Air	Temp. °C Day-Degrees
Autumn Wheat—Alsace		48° 48'	137	15	2055
Autumn Wheat—Alais		44° 7'	146	14.4	2092
Autumn Wheat—Kingston		41° 50'	122	17.2	2098
Summer Wheat—Alsace		48° 48'	131	15.8	2069
Summer Wheat—Kingston		41° 50'	106	20.0	2120
Summer Wheat—Cincin'ti		39° 06'	137	15.7	2151
Summer Wheat—Truxillo		9° 00'	100	22.3	2208
Summer Wheat—Quinch'i		0° 14'	181	14.0	2230
Winter Barley—Alsace		48° 48'	122	14.0	1708
Winter Barley—Alais		44° 07'	137	13.1	1795
Winter Barley—Kingston		41° 50'	92	19.	1738
Winter Barley—Santa Fe		4° 35'	122	14.7	1793
Winter Barley—Cumbal		0° 00'	168	10.7	1798

a. Abbe—Climate and Crops. p. 73.

Three instructive conclusions are deducible from this table.

1. Within narrow limits a definite quantity of sunshine or heat is required.

2. Total quantity required increases as latitude decreases.

3. Above a certain latitude the number of days without frost would become so few or the average temperature of these days would fall so low that the product of the two factors would not make the proper number of day-degrees, and thus is determined by one means at least the poleward limit for certain crops.

Certain plants will do well within a certain range of temperature or in lands whose minimum is not below a certain figure. Others survive if the minimum temperature is only of short duration, but cannot live through long periods of certain low temperatures. Observations on these temperature relations have led to the conclusion that certain lines of mean annual temperature and others of mean range of temperature are more important in horticulture than parallels of latitude. From a botanical point of view the northern mean annual isotherm of 68 degrees F. (line passing through all points north of equator having an average temperature of 68 degrees F.,

see Fig. 2), is a much more effective barrier and a better zonal boundary than the parallel of 35 degrees, which it frequently crosses in its course around the world. Other similarly determined isotherms are fully as significant.

Moisture is an equally important factor. Both the amount precipitated, the frequency and distribution through the year and the "heaviness" of the individual shower are important. Then there are a half dozen miscellaneous, less important factors as follows: winds, rapid thaws and rapid freezes, range of temperature, number of days below frost, number of days with no rain, organic dust, inorganic dust, atmospheric electricity and atmospheric composition.

Each of these climatic factors mentioned and particularly the first five or six have definite distributions on the earth. They have been mapped and

temperature distribution is shown in Fig. 2. Sunshine depends on latitude, and on cloudiness or other obstructions in the air. Temperature (see Fig. 2) depends on a long list of factors, as distribution of land and water, winds, barriers to winds, etc. Moisture depends on distribution of land and water, temperature and altitude, etc. If each factor had a similar belted distribution climatic belts or areas would be easily resolved but as it is there are many types of climate and each belongs to a specific area, not a belt. These areas are limited in extent and often isolated from others having similar climates. (See map, Fig. 1.) Hence in each climatic area there has grown up a flora which cannot conveniently migrate to any other area because of climatic barriers although there may be other areas with climate favorable to the development of its members. Here is where

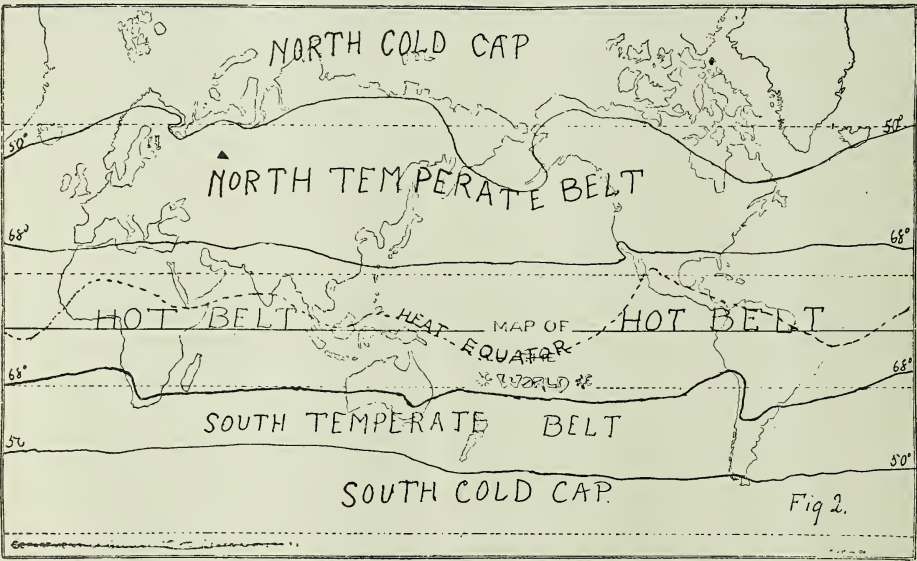


Fig. 2. Adapted from Supan. The broken line passes through the point on each meridian having the highest mean annual temperature. The hot belt is bounded by the mean annual isotherms of 68° F. (20° C.), and the poleward boundaries of the temperate zones are the isotherms of 50° F. (10 C°.) for the warmest month.

the work of the plant introducer comes into play. It is his desire to find what plants can be grown to advantage where now the land is waste, or to find a place nearer the consumer where cer-

tain desirable plants can be made to yield. Two methods of procedure are open to one, each adapted to the end in view.

If the plant introducer knows what

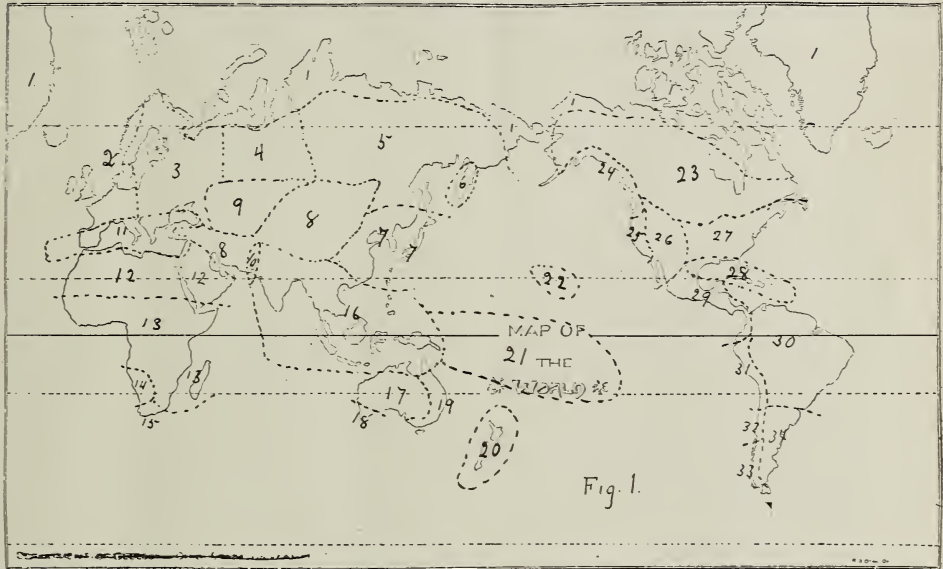


Fig. 1. Adapted from Supan. Broken lines mark off thirty-four climatic provinces. Characteristics of each province are dependent on the whole list of climatic factors entering into the climate of the province. Temperature, rainfall, both amount, nature and seasonal distribution, winds, humidity, etc., are all considered. The regions are named as follows:

- | | | |
|----------------------------------|------------------------------|--|
| 1. Arctic. | 12. Saharan. | 24. Northwest American Coast. |
| 2. West European. | 13. African Tropical. | 25. Californian. |
| 3. East European. | 14. Kalahari. | 26. North American Mountain and Plateau. |
| 4. West Siberian. | 15. Cape. | 27. Atlantic (East North American). |
| 5. East Siberian. | 16. Indo-Australian Monsoon. | 29. Tropical Cordilleran. |
| 6. Kamchatkan. | 17. Inner Australian. | 30. South American Tropical. |
| 7. Sino-Japanese. | 19. East Australian. | 31. Peruvian. |
| 8. Asiatic Mountain and Plateau. | 20. New Zealand. | 32. North Chilian. |
| 9. Aral. | 21. Polynesian Tropical. | 33. South Chilian. |
| 10. Indus. | 22. Hawaiian. | 34. Pampan. |
| 11. Mediterranean. | 23. Hudson (North Canadian). | |

plant he wants to introduce into a certain country so as to reduce its cost to the consumer, he studies its local habitat where it grows successfully, learns its environment as to sunshine, temperature, rainfall, average and extreme conditions of climate, and the soil and exposure the plant prefers. Then he goes to the country into which he desires to bring his plant and seeks for the place having conditions nearest like those to which the plant is adapted.

If, on the other hand, he has an unprofitable area and wants to introduce upon it some profitable fruit, he studies the conditions of the region carefully and then seeks in foreign lands a place having similar conditions. Climatic charts will materially aid him here. Having found the place, he selects its useful fruits, and plants them in his barren area. It all looks very simple and if this were all it would be, but unfortunately too often his observations are faulty. He has failed to take note of some item in the environment and his selected plant will not thrive in its new home. Several more intricate plans are open to him. Sometimes the plant is grown at an intermediate station for a generation or two to permit it to become more nearly adjusted to the new home conditions. Sometimes by semi-artificial cultures in the new home, applying irrigation, shade, or some other aid to the plant for a few years it is brought into sufficiently perfect adjustment to reproduce its kind and be profitable to the culturist. Some plants will become adjusted even if the new conditions do not exactly duplicate their old home.

Not infrequently, however, and for no reason that the experimenter can discern the importation never results in a real introduction. The plant refuses to adopt a new home.

In summing up it may be said that the plant's success and even its existence are largely under the influence of climate and soil, and that the relation of plant and climate is most intricate and even subtle. But in many cases by a thorough study of the problem a plant may be introduced into new places which are more or less perfectly suited to its needs.

Development and Evolution of Spraying Machinery

HOWARD J. CAMPBELL.

The spray pumps which were at the command of the fruit growers and horticulturists twenty to twenty-five years ago would hardly be recognized as the prototype of the apparatus at one's disposal at the present time. The development of spraying began about the time that the injurious insects and fungi began to threaten and destroy so many of our cultivated plants. Many crude contrivances were used and the early history reveals many appliances which are no longer in use, the names even being nearly as obsolete as the machines.

The first and simplest device for making liquid application to the stems and foliage of plants was probably a whisk of heath, straw, or some similar material; the stems were tied in small bundles, the part above the tie serving for a handle. Brooms were also used for the same purpose. The liquid was applied by first dipping this crude brush or broom into it and then throwing upon the plant what adhered to the brush. A fairly good application can be made in this manner, although the process is a tedious one. This device was, nevertheless, used as late as 1882 in France, for the purpose of applying mixtures composed of sulphate of copper and lime. It is probable that the density of this prepa-

ration prevented its being applied by means of other devices then known.

The next step in the development was that of the hollow handle broom. The liquid which was carried in a tank on the back of the operator, entered the hollow handle through a tube connected with the bottom of the tank. The fluid then ran along the fibers of the broom, and was thrown from the extremities. A stopcock was inserted in the handle so that the liquid could be shut off when desired. This device was used in France for applying the Bordeaux mixture.

The watering-can is one of the first contrivances made for applying liquids upon plants. Its structure, as a rule, is very simple, being composed of nothing more than a cylindrical reservoir capable of containing one or more gallons of liquid. This device is still in very common use, especially among florists. The water or other liquid is poured out through a tube which projects on the outside of the reservoir, and which springs from the bottom or from near the bottom of the can. These tubes vary in lengths and shapes, and are often jointed; the cans also differ much from each other. The water may be broken up into fine drops by means of a perforated disk, which covers the outer opening of the spout, the size of the drops varying with the size of the holes in the disk.

Small hand-pumps, commonly called syringes, came into use at an early day. They were very simple in construction, and were at first used almost entirely for throwing clear water upon cultivated plants. They consisted of practically nothing but a tube in which a piston and piston rod could play. The water was thrown out of the same orifice through which it entered. Such a contrivance admitted of considerable varia-

tion, and several styles have been described in early publications.

A more complicated form of syringe includes those which are supplied with valves, generally having two. In such syringes the liquid does not leave the cylinder through the same orifice at which it entered, but it passes out through another. These orifices are each supplied with a valve which allows the free passage of water in the desired direction, but prevents its return.

The Whitman's fountain pump became most popular now. It was used in applying paris green or any other solution to fruit or ornamental trees. It will throw a stream thirty feet high, sixty horizontally, and works so easily that a child five years old can operate it. It can also be used advantageously in watering plants.

Garden engines were designed to throw larger amounts of liquid than could be well done with hand syringes, and they were also generally arranged so that a considerable amount of liquid could be transported from one part of the grounds to another. A large number of different kinds were made, but the majority of them consisted of a force pump fastened upon a tank. The pumps, tanks and the devices for transporting the outfit, differ considerably, all were designed to throw clear water, or solutions which contained no coarse particles. The nozzles used were very simple in construction.

The appearance of the potato beetle in the eastern and central portions of the United States, familiarized farmers with the use of paris green, the use of this poison proving to be the easiest and most effectual method of dealing with the insect. This called for an improved method or machine for its application. The knapsack pumps answered the call.

The first ones used in America were imported from France, and it was not until 1890 that Americans began seriously to consider their manufacture. Various modifications of this pump were then placed on the markets of this country.

Barrel pumps and sprayers were developing rapidly. There seemed to be a boom on in spraying apparatus, owing perhaps mostly to the leading entomologists of the country urging the farmers to spray; and these in turn made demands upon the manufacturer. Firms wrote: "We are unable to supply the demand."

The first successful use of steam power for spraying was made, as near as can be ascertained, by Stephen Hoyt, New Canaan, Connecticut. The outfit was operated in 1894. The success of this one machine has brought about the modern steam sprayer of today.

Such has been the evolution of spraying apparatus. While no pumps or piece of apparatus can be said to be perfect, or to have all the good points, yet the fact remains that spraying apparatus, generally speaking, has been brought to a high degree of perfection. There are now obtainable at moderate cost almost numberless different styles of pumps, any one of which would doubtless give satisfaction to the user.

Soil Moisture

BY H. C. GREEN.

One of the most important problems connected with modern agriculture is that of soil moisture. It is the most uncertain factor in crop production. The absence of moisture is perhaps the main cause of poor crops. The importance of water to the growing plant can be, to some extent, comprehended when we know something of the amount of water

necessary to produce a ton of dry matter in the different crops.

Experiments have shown that 300 tons of water to one ton of dry matter is a conservative average of our common crops. From this it can easily be seen that a liberal supply of soil moisture is necessary in order to get vigorous and healthy plant growth. The presence of water seems to be necessary for the process of nitrification and organic decomposition to take place.

The deficiency of water in the soil at critical times is not due to an insufficient rainfall, but rather to the fact that the rainfall is so unequally distributed throughout the year.

The soil is not able to store up and hold enough moisture from the wet periods to tide the plants over the long dry periods. This raises an important question: Can we so aid the soil in storing up and conserving this moisture that the plants will have a sufficient amount when the long dry periods come? Experiments and common observation have shown that we can, or at least, that we can help out to a marked degree.

Moisture is lost to the soil in three ways: 1. By surface drainage. 2. By underground drainage. 3. By evaporation. If we can do anything to prevent its loss by any of these methods, we will conserve it in the soil. This can be accomplished in many ways. The means most commonly used are: 1. Tillage and Cultivation. 2. Subsoiling. 3. Rotating the crops to get more humus in the soil. 4. Mulching. 5. Manuring.

1. Tillage and Cultivation. These are the methods universally employed for the conservation of moisture. Tillage loosens the soil to a depth of several inches, allowing the rains to penetrate deeply into the soil. Cultivation forms a dust mulch, and this prevents the loss of water by evaporation. Experiments

have shown that fall-plowed land gathers more moisture through the winter than that left unplowed; so it is in better condition to meet the demands of the crop. If spring plowing is practiced, it should be done as early in the spring as is safe, because in the spring the loss of water from unplowed is very large. The plowing breaks up the capillary connection and also forms a sort of dirt mulch.

Much work has been done by experiment stations over the country as to the relative effects of deep and shallow cultivation on the conservation of moisture. The results do not all agree, but it is generally found that three inches deep gives the best results. If shallower than this it should be practiced very frequently. Another way cultivation conserves moisture is by destroying weeds, which are a constant drain upon the soil. In speaking of the value of tillage and cultivation, L. A. Clinton of the Cornell station says: "The importance of thorough tillage to conserve moisture can not be made too emphatic. Deficiency in rainfall with intensified agriculture is preferable to abundant rains and neglect by the cultivator.

2. Subsoiling. This is an operation that should be well studied before being practiced. In some cases it is advisable, or is almost absolutely necessary in order to obtain good crops. Subsoiling is for the purpose of bettering the physical condition of the soil, thereby making it more absorptive and more retentive of moisture. T. L. Lyons, of the Nebraska station, has done considerable work along this line, and some of his suggestions and conclusions seem to me to be especially valuable. He says:

"Where there is a hard, dry subsoil, subsoil plowing is to be recommended."

"Where the subsoil is loose, gravelly, or sandy, subsoiling is unnecessary and may be injurious."

"Subsoiling when the ground is wet may cause puddling."

"If the ground be subsoiled in the fall, the winter and spring rains have ample opportunity to soak in, that being the season of greatest rainfall and least evaporation."

"Subsoiling should be done in the spring only in case of a wet spring."

3. Rotating the Crops to Get More Humus in the Soil. Humus in the soil increases the capacity of the soil for absorbing and retaining moisture. By rotating crops, and allowing our fields to lie in meadow or pasture, legume or otherwise, at regular periods, and then plowing the sod under, we greatly increase the humus content of the soil; by so doing we increase the capacity of the soils for absorbing and retaining moisture.

4. Mulching. Any covering of inert material, as dead plants, straw, stable manure, gravel, wood, etc., increases the moisture of the soil, during warm seasons, because such a covering affords protection from evaporation, and brings water up from below by capillarity. Experiments show that the loss of moisture from the soil decreases as the thickness of the mulch increases. This is true on all kinds of soils. Nature's way of conserving moisture is by a surface mulch of leaves and decaying vegetable matter, thus adding humus to the soil. We would do well to imitate nature in this point of mulching. Mulching is especially valuable to the truck farmer, being often the difference between success and failure.

5. Manuring. We usually think of applying manure to our land only to increase its fertility. We hardly think of it as having any effect on the moisture in the soil; yet this is a very important function of manure. King, of Wisconsin, has shown that manure increases the

moisture in a soil to a depth of four feet, and that the results can be seen a year, or longer, after the manure has been applied. Some caution is necessary as to the plowing under of coarse manure. When it is plowed under, it dries out the ground by preventing capillarity. The practice should not be followed, especially in dry seasons. When manure is rightly handled, the moisture will be conserved, the surface feet being made more moist, and the influence will be the more marked the drier the season.

From the foregoing statements, it can be seen that the capacity of our soils for moisture can be increased, the moisture can be conserved, and by so doing we can greatly increase our crop production. This is a great problem, both for the present and for the future.

As we come more and more to intensive farming, it will become increasingly important. Even now, if not actually the difference between success and failure, it very materially affects the profits.

The Clover Root Borer

Over various portions of the state the effects of this pest are seen. During this past season in the southwest counties a great many acres were ruined. The hay was not worth cutting at all in many places and after some observation thousands of these pests were found.

The clover root borer or *hylastes trifolii* is an introduced species, its native home being in Central Europe. It was very destructive there and as early as 1844 its life history had been carefully studied out. It was first found in New York, about 1878, from whence it spread rapidly westward appearing in Ohio about twelve years later.

It seems that there were two courses

of diffusion over the state, one being directly from New York and entering the northern counties where it was first observed; the other by the way of the Ohio river. Plants containing the insect were carried by tributaries into the Ohio; during the summer this trash was deposited upon the lowlands along the southern border of the state. Thus gaining a foothold they gradually spread northward to meet the oncoming invasion from the north.

The life history of this insect is about the same throughout the state. The eggs are laid during the latter part of May or first of June, in cavities in the crown of the plant, that have been gouged out by the female. They are five or six in number and are very small. After about a week they hatch and the young grubs begin to feed and burrow through the root system of the plant. The results of this may be seen during the latter part of summer by pulling up a handful of the plants. They break off at the top of the ground and the crown will be eaten so that it is impossible for the plant to thrive.

The larvae is white in color, with a yellowish head and dark brown jaws. It is about an eighth of an inch long; it is helpless and cannot travel from one plant to another. The adult is a trifle shorter, and is a brownish, black colored beetle. Therefore it has wings and can fly to new fields to deposit eggs.

There is only one brood a year and as has been intimated the injury is done by the larvae or grub. From the time of the season that the eggs are laid, we can understand that it is only those plants that are starting on the second years growth that are subject to attack. The injury is largely done before the middle of July; if the season be somewhat dry the effect will be seen earlier in the season, instances having been

noted where the first crop was almost ruined. If the season be favorable a fair crop may be harvested, but after that the vitality of the plant is so low that it can never recover and the chances for a crop of seed or hay are ruined.

As is true in combating most insects the best time is when they are in a helpless condition. The infested plant is full of such larvae about the middle of July or shortly after harvest. If the sod is plowed under at this time the greater majority of these grubs will be killed. But if plowing is put off until the next season, the adult will emerge as usual, when the warm days of May come and fly to other fields nearby.

An interesting experiment was conducted at the Ohio station in the year 1899 by Prof F. M. Webster. A plot of clover was found that was badly infested. On July 8 the plot was plowed, the depth of plowing being from four to five inches. A month later a careful examination was made and only one pupae and three nearly full grown larvae were found within three inches of the surface; several were found at a depth of five inches in the dead and decaying roots. On September 20 further digging failed to reveal a single individual. On the unplowed fields close by examination showed that there were a great many adults, pupae and nearly full grown larva. A month after this nearly half the plot was dug and only four or five beetles were found, but in the fields nearby they were abundant.

The results of this experiment are evident; the borers must either have perished or migrated. Beetles do not migrate until spring, but to be sure, a cage was placed over a portion of the

area; no borers ever appeared in it. Hence early summer plowing is given as a remedy, and no doubt badly infested communities could do much to eradicate the pest.

S. B. Stowe.

To a Ben Davis Apple

I've saved this roast for thee—thou false alarm!

Thy rosy cheek and winsome outward charm

Are but deceit. Within thy gay outside—

Within the confines of thy lying hide—
Is juiceless pulp, dry pomace, where
should be

Grand cider that should hint of rural spree.

Oft have I piped thee on the fruiter's stall

(A wrongful place—thou art not fruit at all!)

Good shekels have I jingled on the board

Whence raked this fruiter man his ill-got hoard;

Bit on thee greedily with eager tooth—
Then longed for good, old rambos
known in youth.

Thou art an apple; yet, by hen; not that.

Thou art a nuisance, or I'll eat my hat—

As well, indeed, eat that as thou, bum bunch

Of stiff but fitted for a dead man's lunch!

I blithely loathe thee, yet no doubt again.

I'm like as not to buy thee on the train.

—Strickland W. Gillilan, in American
Grange Bulletin.

Dairy Notes

R. J. Perkins, formerly assistant to Mr. Guthrie in butter making, has secured a position on Judge Philips' dairy farm at Hudson, O. This is a new herd of Jersey cows and Mr. Perkins has charge of the creamery. They will endeavor to make 50-cent butter for the Cleveland market.

Wm. G. Vanmeter, who has been working in the dairy department this winter, has accepted a position as assistant manager on the Harvest Home Dairy Farm at Westchester, Pa. Mr. Vanmeter has complete charge of the handling of the milk.

John S. Bailey, a short course dairy student this winter, has just taken charge of a cooperative creamery in Trumbull county. This is one of the larger cheese factories in the state. He handles twenty thousand pounds of milk a day. His salary is \$75 a month.

L. Stanfield returns to the Conover Creamery at Greenville, O., and receives a raise in salary of \$15 per month.

The first year men are scattered over the state in skimming stations and factories.

Of the second year men, W. A. Wealdon goes to an ice cream and butter factory south of Columbus.

P. H. Wetmore returns to his father's farm at Canfield, O., to assist in caring for a pure bred Jersey herd and take charge of the butter making.

E. J. Milner will assist the dairy department in conducting official herd tests in different parts of Ohio.

The following second year men received certificates showing that they had completed the short course in dairying: L. Parker, Thad B. Carter, W. A. Wealdon, P. H. Whetmore and E. J. Milner.

The Dairy Department received more calls for men than it could fill. There is an urgent demand for long course men in dairying.

Recent Purchases by the Animal Husbandry Department

At the Berkshire sale held at the State Fair grounds March 12 and 13, Prof. Plumb purchased three English bred gilts for the University. One of these was secured from Mr. W. H. Durham, of Toronto, Canada. She was bred to the imported British Sovereign, the undefeated champion. In 1906 this boar was the champion and silver medal boar of the great Canada National Exhibition, Toronto.

The other two were secured from Mr. John Kennedy, of Youngstown, O. Their breeding is of the very best that the English breeders have produced.

The department has been very fortunate in securing the two imported Percheron mares, Coquette and Pervenche, from the Hartman Stock Farm. Coquette has been shown by them for several years, winning many premiums. She is an especially good type of Percheron mare, carrying size and lots of quality. She has been pronounced by several horse judges as "the best type of Percheron mare that they know of."

Pervenche does not carry as much size or finish but is far better than anything seen by the department in their search for Percheron mares.

Alumni and Ex-Student Notes

L. A. Dunlap, ex-'04, is farming near Williamsport, Ohio.

H. D. Bousher, ex-'06, is the owner of a practical stock farm near Hume, Ohio, where he is proprietor of the farm and deals in live stock.

Eva N. Dixon, ex-'01, is doing research work at the Missouri Botanical Gardens of St. Louis.

Paul Fischer, B. Sc. (Agr.) '91, D. V. M. '92, is present State Veterinarian of Ohio, located at the State House.

Allen L. Comstock, ex-'01 is manager of the College Creamery, at Orrville, Ohio.

C. F. Solether, ex-'02, is cashier of the Cygnet Savings Bank, Cygnet, Ohio.

Lawrence A. Kolbe, ex-'01, is making experiments upon soils for the United States Bureau of Soils. He now holds the position of assistant in soil management, Washington, D. C.

W. H. Uncapher, ex-'09, is engaged in horticulture and agriculture near Marion, Ohio.

Miss Emma E. McKinley, '05, is supervisor of domestic science in the public schools of Dayton.

E. L. Shaw, '03, is in charge of the sheep at the Bureau of Animal Industry at Washington, D. C.

Otto Hastings, ex-'08, who has been working in Columbus during the winter, has left to hire out to a company that has charge of trimming trees in New York. He has a good position, with good pay, and expects to camp out along the Hudson during the summer.

H. E. Johnson, ex-'04, has charge of the vacuum pan for condensing milk in a plant at Simons, Ashtabula county, Ohio.

A. H. Betts, ex-'02, is engaged in manufacturing of cheese at Kinsman, Ohio.

C. B. Steward, '00, who has been secretary of the Ohio Short Horn Breeders' Association, is now superintendent of the Steward-Dawreil Ranch of Red Cloud, Neb.

Arthur G. Abbott, '99, is a dairy farmer near Wadsworth.

Chas. R. Adams, ex-'04, is an accountant in the supply department of the Wabash Railroad at Toledo, Ohio.

The lecture by Mr. Earnest R. Root, of Medina, O., given under the auspices of the Horticulture and Forestry Club, on Thursday, March 7 was well attended by students and members of the faculty. The lecture was illustrated by stereopticon slides, showing the various phases of the bee-keeping industry. The lecture closed with a demonstration inside a large wire cloth cage in which Mr. Root with bare hands, arms and face, handled the bees as so many flies. Mr. Root certainly proved to the satisfaction of his audience that he not only knew how to handle bees himself, but that he could also teach others how to do likewise, without longer being stung; this he did by calling for volunteers to come inside the cage with him, and to this three "Ags." responded.

The Horticulture and Forestry Club has had an unusually successful year, both as regards increase in membership and quality of programs rendered at the regular meetings, and an interesting series of meetings are expected during the coming spring term.

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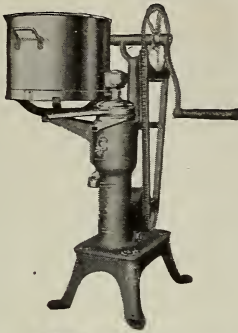
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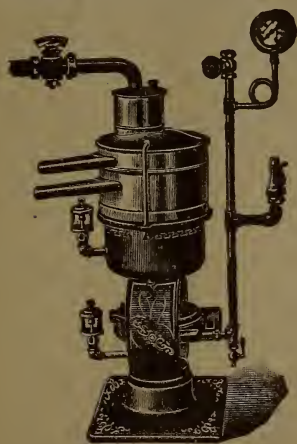
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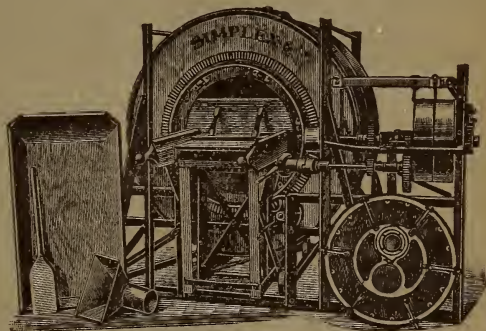
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